APPENDIX C

Health and Safety Technical Report

HEALTH AND SAFETY TECHNICAL REPORT

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HEALTH AND SAFETY TECHNICAL REPORT

Affected Environment

Transmission facilities provide electricity for heating, lighting, and other services essential for public health and safety. These same facilities can potentially harm humans. Contact with transmission lines or any electrical line can kill or seriously injure people. Transmission structures and conductors can present an obstruction for aircraft. This technical report describes public health and safety concerns such as electrical shocks, fires, aircraft obstruction warnings, the effects of electric and magnetic fields related to transmission facilities, and construction activities.

The Federal Aviation Administration (FAA) establishes requirements for towers and other tall structures that would potentially interfere with aircraft safety. Structures taller than 200 feet may require flashing warning lights for aircraft safety. BPA submits the final locations of structures and structure heights to FAA for their review and recommendations on airway marking and lighting.

Transmission lines, like all electric devices and equipment, produce ***electric and magnetic fields (EMF)***. Voltage, the force that drives the current, is the source of the electric field. Current, the flow of electric charge in a wire, produces the magnetic field. The strength of electric and magnetic fields depends on the design of the line and on distance from the line. Field strength decreases rapidly with distance.

Electric and magnetic fields are found around any electrical wiring, including household wiring and electrical appliances and equipment. Electric fields are measured in units of volts per meter (V/m) or kilovolts per meter (thousands of volts per meter, kV/m). Throughout a home, the electric field strength from wiring and appliances is typically less than 0.01 kV/m. However, fields of 0.1 kV/m and higher can be found very close to electrical appliances.

There are no Federal guidelines or standards for electric fields from transmission lines. Washington has no electric-field limit. BPA designs new transmission lines to meet its electric-field guideline of 9-kV/m maximum on the ROW and 5-kV/m maximum at the edge of the ROW. The National Electric Safety Code (NESC) specifies that the maximum permissible induced shock current from large vehicles under transmission lines with voltages above 170 kV cannot exceed 5 milliamperes (mA). This portion of the NESC does not apply to the proposed 115-kV line. Both the BPA guideline and the NESC induced current requirement are important for 500-kV lines. The proposed 115-kV line would have much lower fields than a 500-kV line and would easily meet all these requirements.

Magnetic fields are measured in units of gauss (G) or milligauss (thousandths of a gauss, mG). Average magnetic field strength in most homes (away from electrical appliances and home wiring, etc.) is less than 2 mG. Fields of tens or hundreds of milligauss are present very close to appliances carrying high current. Typical magnetic field strengths for some common electrical appliances are given in Table 1. Unlike electric fields, magnetic fields from outside power lines are not reduced in strength by trees or building material. Transmission lines and distribution lines (the lines feeding a neighborhood or home) can be a major source of magnetic field exposure throughout a home located close to the line.

There are no Federal guidelines or standards for magnetic fields. Washington does not have magnetic field limits. BPA does not have a guideline for magnetic field exposures. Guidelines for public and occupational magnetic-field exposures are well above environmental levels and above the levels found near transmission lines. These guidelines are based on short-term stimulation, not effects of long-term exposures.

Table 1: Typical Magnetic Field Strengths
(1 foot from common appliances)

Appliance	Magnetic Fields (mG)[1]
Coffee maker	1-1.5
Electric range	4-40
Hair dryer	0.1-70
Television	0.4-20
Vacuum cleaner	20-200
Electric blanket[2]	15-100

mG = milligauss
[1] The magnetic field from appliances usually decreases to less than 1 mG at 3 to 5 feet from appliances.
[2] Values are for distance from blanket in normal use (less than 1 foot away).
Source: Miller 1974; Gauger 1985

Environmental Consequences of the Proposed Action

Potential health and safety impacts associated with the project include those that could affect construction workers, operation and maintenance personnel, the public, and others who have occasion to enter the project corridor.

Potential Impacts

Potential Impacts During Construction

During construction and installation of the structures and conductor/ground wires, there is a risk of fire and injury associated with the use of heavy equipment, hazardous materials such as fuels, cranes, helicopters, and other activities associated with working near high-voltage lines. There is also a potential for fire during refueling of hot equipment such as trackhoes and bulldozers that cannot be taken off site for refueling. Connection of conductors may be accomplished using implosion fittings, which could be a source of injury to construction personnel. In addition, there are potential safety issues with more traffic on the highways and roads in the project area during construction. Standard construction safety procedures would make the risk of injury very low.

Potential Impacts During Operation and Maintenance

Electrical Safety

Power lines, like electrical wiring, can cause serious electric shocks if certain precautions are not taken. These precautions include building the lines to minimize shock hazard. All BPA lines are designed and constructed in accordance with the NESC and BPA practices. The NESC specifies the minimum allowable distance between the lines and the ground or other objects. These

requirements determine the edge of the ROW and the height of the line; i.e., the closest point houses, other buildings, and vehicles are allowed to the line.

People must take precautions when working or playing near power lines. It is extremely important that a person not bring anything, such as a TV antenna, irrigation pipe, or water streams from an irrigation sprinkler too close to the lines. BPA provides a free booklet that describes safety precautions for people who line or work near transmission lines (*Living and Working Safely Around High Voltage Power Lines*). Given that the new line would be higher than the existing line, impacts related to electrical safety would be reduced relative to the existing line.

Short-term Effects – Electric Fields

Electric fields from high-voltage transmission lines can cause nuisance shocks when a grounded person touches an ungrounded object under a line or when an ungrounded person touches a grounded object. Transmission lines are designed so that the electric field would be below levels where primary shocks could occur from even the largest (ungrounded) vehicles expected under the line. Fences and other metal structures on and near the ROW would be grounded during construction to limit the potential for nuisance shocks. Questions about grounding or reports of nuisance shock received under a line should be directed to BPA. Electric fields from the proposed line would be much lower than those from 230-kV and 500-kV lines. The proposed line would easily meet the BPA electric-field guidelines of 9 kV/m on the ROW and 5 kV/m at the edge of the ROW. Therefore, it is highly unlikely that the above-mentioned effects would be perceived under the line.

Short-term Effects - Magnetic Fields

Magnetic fields from transmission lines can induce currents and voltages on long conducting objects parallel to the lines. These voltages can also serve as a source of nuisance shocks. However, the effects are well understood and can be mitigated by grounding and other measures. Magnetic fields from transmission lines (and other sources) can distort the image on computer monitors. The threshold for interference depends on the type and size of monitor. Historically, this phenomenon is reported at magnetic-field levels at or above 10 mG, but some more sensitive monitors may exhibit image distortion at lower levels. For the proposed 115-kV line, the distance where interference could occur under worst-case conditions would be reduced to about 40 feet from the centerline.

Long-term Health Effects

The issue of whether there are long-term health effects associated with exposure to fields from transmission lines and other sources has been investigated for several decades. A review of recent literature on this subject was conducted for this project. There is little evidence that electric fields cause long-term health effects. Estimates of magnetic-field exposures have been associated with certain health effects in studies of residential and occupational populations. Research in this area is continuing to determine whether such associations might reflect a causal relationship.

Scientific reviews of the research on EMF and health have stated that there is insufficient evidence to conclude that EMF exposures lead to long-term health effects, such as adult cancer, or adverse effects on reproduction, pregnancy, or growth and development of the embryo. Based on epidemiology studies, some uncertainty remains about the possible effect of magnetic-field

exposure above 4 mG on the risk of childhood leukemia. However, as the scientific reviews also indicate, animal or cellular studies provide little support for the idea that the statistical associations reflect a causal relationship, i.e., that magnetic-field exposure increases the risk of childhood or adult cancer.

National and international organizations have established public and occupational EMF exposure guidelines on the basis of short-term stimulation effects, rather than long-term health effects. In so doing, these organizations did not find data sufficient to justify the setting of a standard to restrict long-term exposures to electric or magnetic fields.

Electric and Magnetic Field Levels

An increase in public exposure to magnetic fields could occur if field levels increase and if residences or other structures draw people to these areas. The predicted field levels are only indicators of how the proposed project may affect the magnetic-field environment. They are not measures of risk or impacts on health. The 18-mile-long corridor in which the proposed line would be built is sparsely populated along most of its length.

BPA has predicted the annual peak electric and magnetic fields during 2004 from the proposed and existing transmission lines to compare the fields from the proposed line with the fields from the existing line. The predicted levels for electric and magnetic fields are maximum levels that would occur under maximum voltage conditions for electric fields and annual peak current conditions for magnetic fields.

Peak electric field levels are expected to be comparable but slightly less than under existing conditions. The calculated peak electric field expected on the ROW of the proposed line is 1.4 kV/m. The peak values would be present only at locations directly under the line, near mid-span, where the conductors are at the minimum clearance. The calculated peak levels are rarely reached under real-life conditions. The estimated peak electric field under the existing 115-kV line would be 1.5 V/m. The largest value expected at the edge of the ROW of the rebuilt line would be 0.6 kV/m. The estimated largest electric field at the edge of the ROW for the existing line is 0.7 kV/m. Lateral profiles of the maximum electric field levels near the proposed and existing lines are shown on Figure 1.

Peak magnetic field levels are expected to be less than under existing conditions. The peak calculated 60-Hz magnetic field expected at 3.28 feet above ground for the proposed line is 30 mG. This field is calculated for the maximum current of 224 A, with the conductors at a height of 24 feet. The maximum field would decrease for increased conductor clearance. For an average conductor height over a span of 31 feet, the maximum field would be 19 mG. The peak magnetic field during 2004 for the existing line with a clearance of 20.5 feet would be 43 mG. Lateral profiles of the maximum magnetic field levels near the proposed rebuilt line and the existing line are shown in Figure 2.

At the edge of the ROW of the proposed line, the calculated magnetic fields for maximum current load conditions are 18 and 14 mG on either side of the line. The higher fields would be on the side of the line with the lowest conductor. The calculated magnetic fields of at the edge of the ROW of the existing line are about 17 mG. Magnetic fields averaged over a year would be about one-half the estimated maximum values.

The magnetic field would fall off rapidly as distance from the line increases. At a distance of 100 feet from the centerline of the proposed line, the field would be about 2 mG for maximum

current conditions. The calculated magnetic field for maximum current would be less than 10 mG at about 40 feet from the centerline.

The public health and safety impacts associated with electric and magnetic fields for the proposed action would be comparable to those from the existing line. The magnetic fields from the proposed line would be less than those from the existing line. Short-term effects, such as nuisance shocks, would be very unlikely.

Toxic and Hazardous Substances

There are no known occurrences of hazardous materials or contaminants within the transmission line corridor; no impacts are expected.

Figure 1: Maximum electric field at 3.28 ft. height from proposed and existing Raymond – Cosmopolis 115-kV transmission lines.

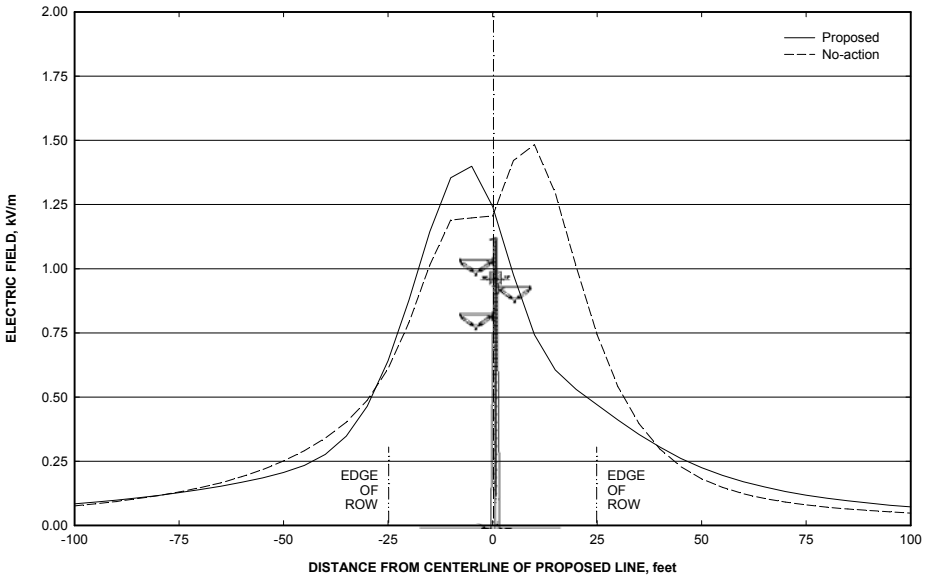

Figure 2: Maximum magnetic field at 3.28 ft. height from proposed and existing Raymond – Cosmopolis 115-kV transmission line.